MED64 A low-noise multi-electrode array system for *in vitro* electrophysiology

Product Manual

MED64 Main Amplifier

64-CHANNEL MAIN AMPLIFIER
P/N: MED-A64MD1

ALPHA MED SCIENTIFIC

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Safety Precautions

Before using this unit please read these operating instructions carefully. Take special care to follow the warnings indicated on the unit itself as well as the safety suggestions listed below. Keep these precautions at hand for future reference.

Placement

- Avoid placing the unit in areas of:
  - direct sunlight.
  - high temperature.
  - high humidity.
  - excessive vibration.
  - uneven surfaces. (Place the unit on a flat level surface.)

Such conditions might damage the cabinet and/or other component parts and thereby shorten the unit's srvice life.

Stacking

- Never place heavy items on top of the unit, the DC power supply unit, or AC power cord.

Voltage

- Avoid the use of a “high voltage” AC power source. It is an extremely dangerous fire hazard.
- A DC power source cannot be used. Be sure to check the power source carefully.
- The working input voltage range is 90-264V AC.

Power Cord Protection

- Avoid using AC power cords with cuts, scratches, or poor connectors, as this may result in fire or electric shock. Excessive bending, pulling or slicing of the cord should also be avoided.
- Do not pull on the cord when you are disconnecting the power. This could cause an electric shock. Grasp the plug firmly when you disconnect the power supply.
- Never touch the plug with wet hands as a serious electric shock could result.

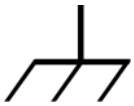
Foreign Materials

- Ensure that no foreign objects (e.g. - needles, coins, screwdrivers), accidentally fall into the unit. Otherwise, a serious electric shock, short circuit, or other malfunction could occur.
- Be extremely careful about spilling water or liquid on or into the unit, as a fire, short circuit, or electric shock can also occur. Disconnect the power plug and contact your dealer immediately if this occurs.
- Avoid spraying volatile chemicals (e.g.- insecticides, alcohol, paint thinner) on or into the unit. They contain flammable gases which can be ignited.
- Insecticides, alcohol, paint thinner and similar chemicals should never be used to clean the unit. They can cause flaking or cloudiness to the cabinet finish.

Service

- Never attempt to repair, disassemble or modify the unit if there seems to be a problem. A serious electric shock could result if you ignore this precautionary measure.
- If a problem occurs during operation (smoke is detected, etc.) contact your dealer immediately.
- Disconnect the power supply if the unit will not be used for a long time. Otherwise the unit's lifetime could be shortened.

Safety-related symbols used on equipment and documentation:



Frame or chases
TERMINAL

Environmental Conditions

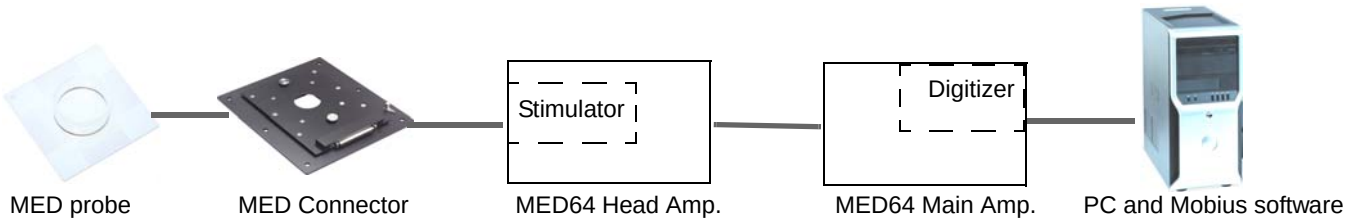
- Indoor use.
- Altitude up to 2000 m.
- Temperature: 5 - 40 °C.
- Maximum relative humidity 80% for temperatures up to 31 °C decreasing linearly to 50% relative humidity at 40 °C.
- Main supply voltage fluctuations not to exceed +/- 10% of the nominal voltage.

Maintenance

- Clean the cabinet, panel and controls with a soft cloth lightly moistened with mild detergent solution.
- Do not use any type of abrasive pad, scouring power or solvent such as alcohol or benzene.
- Supply voltage fluctuations must not to exceed +/-10% of the nominal voltage.

MED64 Main Amplifier Components and Functions

The MED64 Main Amplifier (64-CHANNEL MAIN AMPLIFIER, MED-A64MD1) is the main amplifier for the MED64 System. Filed potentials (extracellular signals) are acquired from the acute or cultured biological preparations placed onto the 64 planar microelectrodes in the MED Probe. The acquired raw signals are amplified by x10 with the MED64 Head Amplifier (64-CHANNEL HEAD AMPLIFIER, MED-A64HE1), then sent to the MED64 Main Amplifier, where input signals are amplified further and digitized. Stimulus current can be delivered via any of the 64 electrodes using the built-in stimulator in the MED64 Head Amplifier.

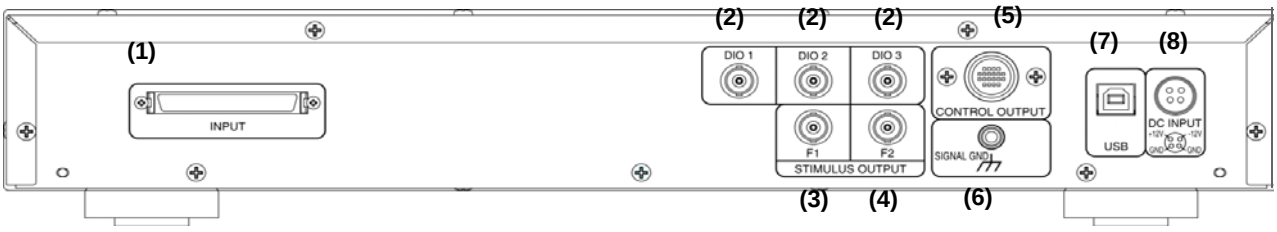


Components and their Functions

Front panel

(1) POWER
Turns amplifier ON and OFF.

Back panel



(1) INPUT
Signal Input. Connects to the [OUTPUT] terminal on the 64-CHANNEL HEAD AMPLIFIER.

(2) DIO 1, 2, 3
Digital Input/Output port to be connected to another equipment provided by Alpha MED Scientific ONLY.

(3) F1 STUMULUS OUTPUT
Output for F1 stimulator. Connects to the [F1 STIMULUS INPUT] on the 64-CHANNEL HEAD AMPLIFIER (MED-A64HE1).

(4) F2 STIMULUS OUTPUT
Output for F2 stimulator. Connects to the [F2 STIMULUS INPUT] on the 64-CHANNEL HEAD AMPLIFIER MED-A64HE1).

(5) CONTROL OUTPUT
Output for control of stimulus channels. Connects to the [CONTROL INPUT] on the 64-CHANNEL HEAD AMPLIFIER (MED-A64HE1).

(6) SIGNAL GND
Ground terminal for signals.

(7) USB
USB port for interface with a PC.

(8) DC INPUT
DC power supply cord inserts here.

Accessories

(1)

(2)

(3)

(4)

(5)

(1) DC Power supply unit -1unit-

(2) 68pin cable -1 unit-
Connects the [INPUT] terminal to the [OUTPUT] on the 64-CHANNEL HEAD AMPLIFIER.

(3) BNC cable -2unit-
Connects the [STIMULUS OUTPUT] to the [STIMULUS INPUIT] on the 64-CHANNEL HEAD AMPLIFIER.

(4) Cable -1 unit-
Connects the [STIMULUS CONTROL OUTPUT] to the [STIMULUS CONTROL INPUT] on the 64-CHANNEL HEAD AMPLIFIER.

(5) USB cable -1unit-
For connecting the 64-CHANNEL MAIN AMPLIFIER USB terminal to the PC.

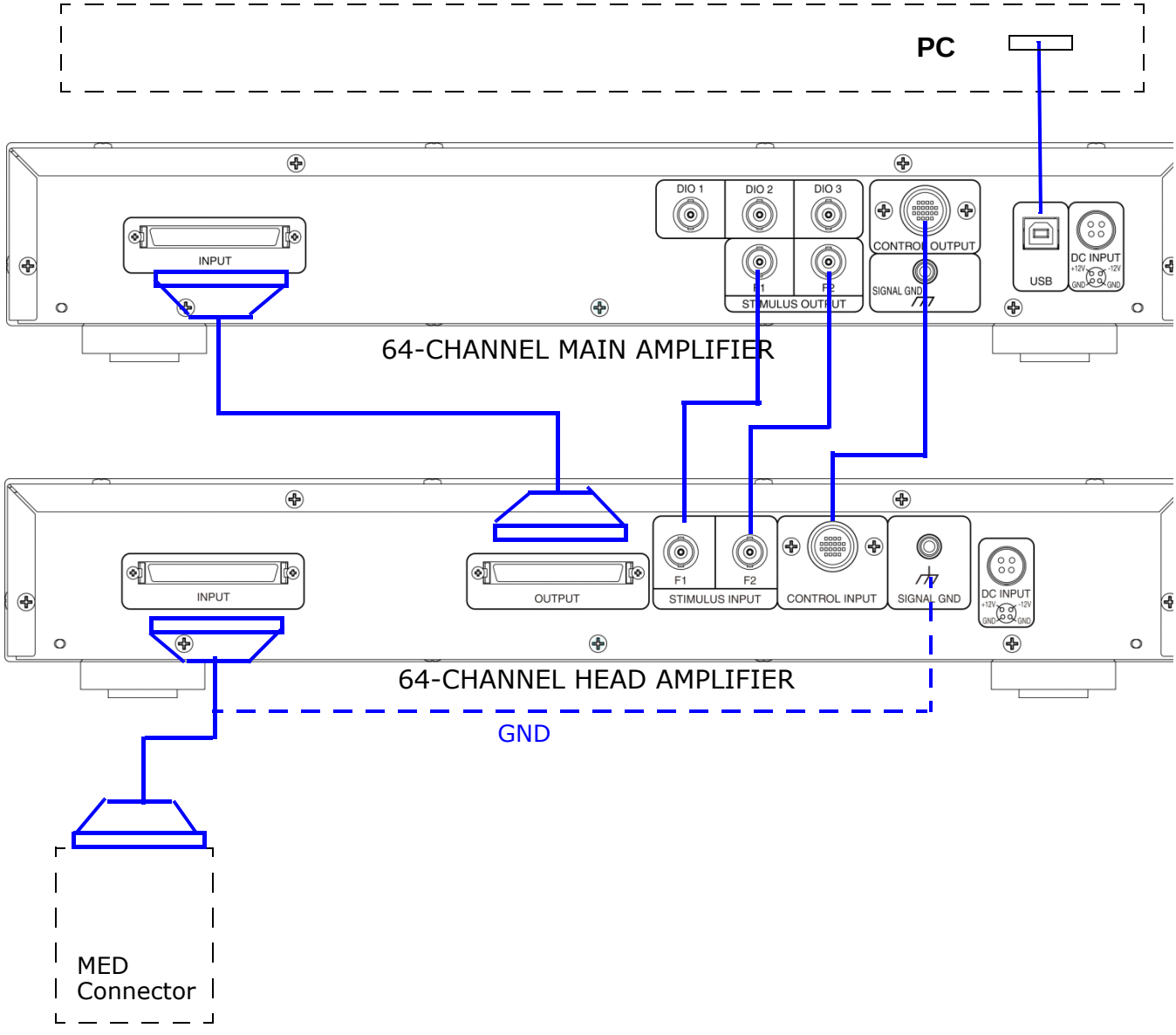
MED64 Main Amplifier Set-Up

The MED64 System has several technical advantages due to the low-impedance platinum-black microelectrodes on the MED probe (typically 10 kΩ at 1kHz for 50 μm electrodes). These include:

1. The system is more resistant to exogenous noise (e.g. hum noise).
2. Very low Johnson noise (baseline noise) as low as a few microvolts can be achieved.
3. The MED Probe/Connector can be physically separate from the amplifier (such as during long-term recordings in a humidified incubator). It is connected with a cable as long as 2m without noise or signal attenuation.

The MED64 System does NOT usually require a Faraday cage or vibration isolation table necessary for the conventional electrophysiology rigs. It is recommended that the MED64 system be installed on a STABLE TABLE such as lab bench using aluminium foil except when the system is used in conjunction with other equipment such as an incubator or microscope. Please refer to "MED64 Handbook Vol1 Hardware" for the installation and operation of the MED64 system.

Connecting the MED64 Main Amplifier to other Components



Amplification Settings

Acquisition-Bandwidth Settings

The MED64 Main Amplifier (64-CHANNEL MAIN AMPLIFIER) has a broad bandwidth range between 0.1Hz-10kHz which allows users to record several types of extracellular potentials. The amplifier has analog low-cut filter settings (high- pass filter) available at 0.1, 1, 10, and 100 Hz cutoffs and high cut filter settings (low-pass filter) available at 1, 2.5, 5, 7.5, and 10 kHz cutoffs, which can be selected in the Mobius software. Signals with frequencies higher than the value set for low-cut filter and lower than the value set for high-cut filter are acquired.

Keep in mind that filtering distorts the signal. Thus, it is usually better to record the signal at a wide bandwidth and analyze the acquired signals using Mobius's digital filter if necessary. The noise level for the MED64 System is very low due to its low-impedance electrodes. Usually a good signal-to-noise ratio can be achieved even with the high-cut filter (low-pass filter) of 10kHz. On the other hand, Setting the low cut filter (high-pass filter) with 0.1 Hz is usually unnecessary except for recording of very slow signals such as from gastrointestinal smooth muscle.

These recording bandwidth settings are recommended:

- fEPSPs: 1Hz -10 kHz
  (1Hz - 2.5 kHz is acceptable to achieve even better signal-to-noise ratio.)
- Neuron spikes (single unit): 100Hz - 10 kHz
- Cardimyocyte signals (FPD analysis): 1Hz - 1 kHz (To achieve the stability for the K^+ release peak time)

Avoid recording with lower bandwidth than indicated above.

Gain Setting

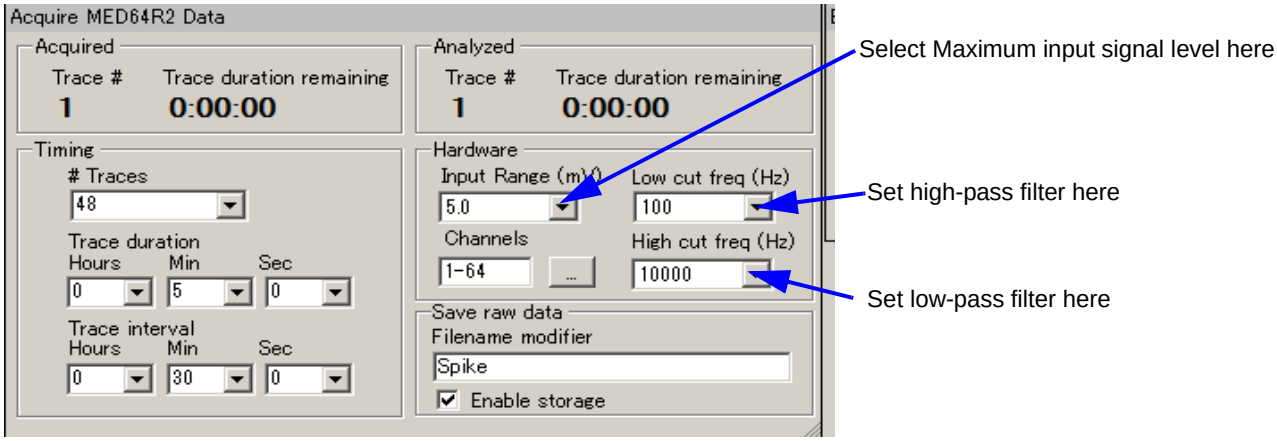
Raw signals are amplified by x10 with the 64-CHANNEL HEAD AMPLIFIER, then sent to the 64-CHANNEL MAIN AMPLIFIER. The Gain at the Main Amplifier is set in the Mobius software by changing the "Input Range" at the Mobius' [Acquire MED64R2 Data] or [Acquire MED64R2 Data w/Stim] control panel.

The "Input Range" selected by the Mobius shows the maximum level of input signal. For example, if 5.0 mV is selected, any signals larger than 5.0 mV are NOT acquired. T**he smaller the maximum input signal levels are, the larger the gain is.** The following chart shows the gain that can be achieved by each maximum input signal level (Input Range) as well as the input signal resolution.

Gain	Maximum input signal level (Input Range set with Mobius)	Input signal resolution
x217	2.3 mV	0.07 μV
x172	2.9 mV	0.09 μV
x100	**5.0 mV**	**0.15 μV**
x40	12.5 mV	0.38 μV
x20	25 mV	0.76 μV

The following Input Range settings are usually recommended:

-fEPSPs: 5.0 mV
-Neuronal spikes (single unit): 2.3 mV
-Cardiomyocyte signals: 2.9 mV, Change to 5.0 mV depending on the size of your signal.
(e.g. Select 5.0 mV when 1 Hz - 10 kHz is selected for recording bandwidth.)



Setting of acquisition-bandwidth and Gain on the Mobius' [Acquire MED64R2 Data] module.
The acquisition-bandwidth is now set for 100 Hz -10 kHz and the Gain is x100.

Warranty

This product will be repaired with new or refurbished parts, free of charge, for one (1) year from the date of original purchase in the event of a defect in materials or workmanship.

The product warranty covers failures due to defects in materials or workmanship which occur during normal use. It does NOT cover damage incurred during shipment or problems which are caused by products not supplied by Alpha MED Scientific. In addition, this warranty does not cover problems resulting from alteration, accident, misuse, neglect, faulty installation, maladjustment of user controls, improper maintenance, modifications or service by anyone other than AMS or damage attributable to acts of God.

Specifications

Amplifier

Number of channels	64
Gain	x 1-217
Bandwidth	0.1Hz - 10kHz (+0dB to -3dB)
Analog high cut filter	1 kHz, 2.5 kHz, 5 kHz, 7.5 kHz, 10 kHz (-12dB/oct)
Analog low cut filter	0.1 Hz, 1Hz, 10 Hz, 100 Hz (-12dB/oct)
Input impedance	100 MΩ

Digitizer

Resolution	16 bit
Sampling rate	20 kHz
Output	USB

General

Power supply	DC +/- 12V
Weight	5.9 Kg
Dimensions	W430 x H74 x D437 mm

Power supply unit

Input	AC 100-240 V (50-60 Hz)
Output	DC +/- 12V

Specifications may not be satisfied depending upon the type of computer or operating environments used.
Only for use in animal studies research.
Specifications and external appearance are subject to change without notice.

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